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GENERAL NOTES

The Einstein Theory of Relativity. In consequence of the very interesting results obtained by the British observers of the total eclipse of the Sun on May 29, 1919, to which brief reference was made in the December number of these PUBLICATIONS, the Einstein theory of relativity has become one of the most popular of all topics in current periodical literature, both scientific and unscientific. Many of the statements made in journals of the latter class must amaze the author of the theory; but others are of interest as expressing the bewilderment produced by the apparent demonstration of a theory which is assumed—whether correctly or not—to overthrow the accepted concepts of time and space as well as the Newtonian law of gravitation. We do not often quote poetry (?) in these columns, but the following rhyme really deserves to be copied because it expresses quite accurately (particularly in the closing lines) the state of mind of many usually well informed people. It is taken from B. L. T.'s column in the San Francisco *Chronicle* for January 8, 1920.

EINSTEIN

Twinkle, twinkle, little star,
How I wonder where you are!
'Cording to the new complaint,
Where you seem to be, you ain't.

If your light waves have a kink,
What, on earth, are we to think?
Are you here, or are you there?
You might be 'most anywhere.

Viewed from our terrestrial ball,
Some things are not there at all.
What, for instance, is Orion?
And the Bear? Perhaps, a lion!

Twinkle, twinkle, little star,
How I wonder where you are!
You are less than ever fixed;
I am more than ever mixed.

It also seems desirable to quote the closing passage from an article (too long to quote in full) in the London *Times* (reprinted in *Science* for January 2, 1920) by the author of the theory, Professor Albert Einstein.

"Thus the new theory of gravitation diverges widely from that of Newton with respect to its basal principle. But in practical application the two agree so closely that it has been difficult to find cases in which the actual differences could be subjected to observation. As yet only the following have been suggested:

- "1. The distortion of the oval orbits of planets round the Sun (confirmed in the case of the planet *Mercury*).
- "2. The deviation of light-rays in a gravitational field (confirmed by the English Solar Eclipse Expedition).
- "3. The shifting of spectral lines towards the red end of the spectrum in the case of light coming to us from stars of appreciable mass (not yet confirmed).

"The great attraction of the theory is its logical consistency. If any deduction from it should prove untenable, it must be given up. A modification of it seems impossible without destruction of the whole.

"No one must think that Newton's great creation can be overthrown in any real sense by this or by any other theory. His clear and wide ideas will forever retain their significance as the foundation on which our modern conceptions of physics have been built."

Einstein's statement, "If any deduction from it [the theory] should prove untenable, it must be given up," is of special interest. Just above this statement he gives the only three cases yet suggested in which the theory can be subjected to test by actual observation. Let us consider these briefly.

1. The only planet orbit really available for this test is that of *Mercury*. Grant that the theory here offers an explanation of the observed acceleration of the perihelion; it is also true that there may be an alternative explanation under the Newtonian law of gravitation. Seeliger has shown that the finely divided matter in circulation about the Sun within the orbit of the Earth which is revealed to us by the Zodiacal Light may be competent to produce the observed perturbation.

2. There is no question but that the English eclipse plates show displacements of the stars at the time of the eclipse (when the stars' rays passed close to the limb of the Sun) which are in accord with the displacement predicted by the theory. It is this fact upon which all the recent notice given to the theory rests. It must be remembered, however, that the total displacements are extremely small, and that the absolutely unavoidable errors of measurement amount to a considerable fraction of the entire displacements. The observers themselves were the first to point out this fact and to urge the desirability of repeating the observations at future eclipses to secure confirmation of the present results. Then it must be noted that the displacement, if thus confirmed, may be open to an alternative explanation. So eminent an astrophysicist as Professor Newall of Cambridge (Eng.) said at the

joint meeting of the Royal Society and Royal Astronomical Society at which the eclipse results were formally announced, "I feel that the Einstein effect holds the day, but I do not yet feel that I can give up my freedom of mind in favor of another interpretation of the effects obtained. If Einstein had not existed, or had not predicted a deflection, we might have had a similar experiment made to test the presence of an extended atmosphere round the Sun, and we could have argued from the result back to the hypothesis. * * * * I prefer to keep an open mind about interpretation."¹

3. "The shifting of spectral lines towards the red end of the spectrum in case of light coming to us from stars of appreciable mass" has been very carefully tested in the case of the Sun. Here the magnitude of the shift required by the theory is from 50 to 100 times the error of modern measurement. In fact the predicted shift on plates taken with the powerful equipment on Mount Wilson is almost great enough to be detected, if it exists, by the unassisted eye. In spite of this, Dr. St. John's investigations at Mount Wilson and Mr. Evershed's at the Kodaikanal Observatory, agree in giving negative results. *No displacement at all corresponding to the demands of the theory were detected.*

It thus appears that while two of the tests proposed by Einstein give favorable results, each of them *may* also be accounted for on the old Newtonian theory; and that the third—and this is precisely the one best adapted to accurate and repeated measurement—gives an unfavorable answer. Recalling once more Einstein's words, "If any deduction from it should prove untenable, it must be given up," we may concur in the opinion recently expressed by a number of prominent American physicists that the theory of relativity has not yet been established.

R. G. A.

January 9, 1920.

*The Jubilee Number of Nature.*² The first number of *Nature*, the well known English weekly illustrated journal of science, was issued on November 4, 1869; it is appropriate, therefore, that the issue for November 6, 1919, should be a Jubilee Number, summarizing in brief articles by eminent authorities the progress of science during the half-century of its existence. This is a most

¹The *Observatory*, 42, 395, 1919.

²Received in California just before Christmas, too late for notice in the December number of these PUBLICATIONS.

valuable number and many of the articles it contains will be of special interest to astronomers.

Sir Norman Lockyer, who founded the journal, is still its editor and it is to be hoped that he may long continue to give it the benefit of his counsel and ripe judgment, tho he contributes "Valedictory Memories" as introduction to the present number. We join in the chorus of congratulations to him and to *Nature*.

*A Catalog of 1053 Stars of Large Proper Motion.*¹ Dr. Max Wolf has recently published in collected form the results of his stereoscopic examination of photographic plates, in the years 1915-1918, for the detection of stars having proper motions in excess of 0.1 annually. The majority of the stars (977) in this list were found on plates of 30 regions of the sky distributed as uniformly as the available material would permit along both sides of the parallactic equator. Professor Wolf regards his examination as complete over only the central two-thirds of each plate (star images near the edges of a plate are always poorer than those nearer the center) and on this basis estimates that there may be 42,000 stars as bright as 14th magnitude (photographic) in the sky with motions as great as those here listed. The point of greatest interest in the catalog is, perhaps, the number of stars it contains which are as faint as magnitude 12. At least 10 of these faint stars are assigned annual proper motions of 1".25 or greater, the most remarkable ones being Nos. 359 and 489, each of 13th magnitude, with proper motions of 4".84 and 3".94. Only about a dozen stars bright enough to be observed with the meridian circle have motions as large as these, and less than 100 stars brighter than the tenth magnitude are known to have motions as great as 1".5. The list thus gives observational evidence in support of the belief that there are many very feebly luminous bodies among our nearest stellar neighbors.

Honors Recently Conferred Upon Astronomers. The award of the Bruce Gold Medal of this Society to Professor E. W. Brown, of Yale University, is more particularly noted upon another page. From the *Comptes Rendus* of the Paris Academy of Sciences for December 22, 1919, just received, we learn that the Lalande Prize has been awarded to Dr. V. M. Slipher, director of the Lowell

¹Veroff. d. Sternwarte zu Heidelberg, 7, 195, 1919.

Observatory; the Benjamin Valz prize to M. Felix Boquet, of the Paris Observatory; and the de Pontecoulant (biennial) prize to Professor A. S. Eddington of the University of Cambridge, England. Other prize awards recently announced include the Draper Medal of the National Academy of Sciences to Professor Alfred Fowler, of the Imperial College of Science and Technology, South Kensington, England, and a Royal Medal by the Royal Society of London to Professor J. H. Jeans, of the University of Cambridge, England.

The Royal Institution of Great Britain has elected Dr. W. W. Campbell, director of the Lick Observatory, to honorary membership. This is an honor held by but two other astronomers, Dr. G. E. Hale, and M. Henri Deslandres.

Telescope for Sale. Mrs. Edward Gray, 2731 Regent Street, Berkeley, Calif., offers for sale a 9-inch (Brashear) reflector mounted in a metal tube 6 feet long. The telescope is equipped with driving clock, small finder, and a set of eyepieces with powers to 450; all in excellent condition. Price \$1000. Further information may be obtained by writing to, or calling upon Mrs. Gray at the address given.